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THE RESEARCH CHEMIST, MANKIND'S DEVOTED AND INDISPENSABLE SERVANT[1]

By Professor MARSTON TAYLOR BOGERT

COLUMBIA UNIVERSITY

"TAKE interest, I implore you, in those sacred dwellings which one designates by the expressive term Laboratories. Demand that they be multiplied, that they be adorned. These are the temples of the future—temples of wellbeing and of happiness. There it is that humanity grows greater, stronger, better."

So spoke the immortal Pasteur, and I tender my warmest felicitations and congratulations to Trinity College and her friends on the noble way in which they have responded to that call by the erection of this splendid new Chemistry Building.

I am confident that you all feel as I do, that colleges and other educational institutions exist primarily for service—to the community in which they happen to be located, to the state, the nation and the world.

[1] Address delivered on the occasion of the dedication of the new Chemistry Building of Trinity College, Hartford, Connecticut, October 9, 1936.

Not infrequently, the public as well as the students get a somewhat distorted perspective of the relative importance of a college's manifold activities, in living up to this ideal of service and in meeting the obligations and responsibilities it imposes. There can be, it seems to me, but one order in which to arrange the more obvious of these duties. First and foremost comes the making of great citizens and courageous leaders, of sterling character and high ideals, never more needed by our country than now. The institution that fails to keep this primary purpose always before it voluntarily sacrifices its birthright and is unworthy of support.

As Edwin Markham so admirably expresses it:

> We all are blind until we see
> That in the human plan
> Nothing is worth the making if
> It does not make a man.

Why build these cities glorious
If man unbuilded goes?
In vain we build the world, unless
The builder also grows.

Next, I would place the arousing in the student of an enthusiastic interest in his studies, for once that inspiration is awakened he will require no urging to learn their factual foundations. This is where the genius of the teacher is immediately evident. Students are quick to sense, almost instinctively, whether their lecturer loves his subject or not, and only the individual who himself possesses that divine fire of inspiration can hope to pass it on to others. There is no greater boon within the gift of the teacher.

In third place, I would put the inculcation of the bare facts themselves, for the world is not so much concerned about what you know as it is about what use you make of that knowledge.

The multifarious opportunities for service which chemistry offers may be grouped under the following general headings:

I. The *dissemination* of knowledge by writing, lecturing and teaching.

II. The *application* of existing knowledge to the solution of the problems of industry and of public life.

III. The *discovery* of new knowledge.

It is the last of these, namely, the discovery of new knowledge, that I would like to discuss with you for a few minutes this afternoon, taking as my text, "The Research Chemist, Mankind's Devoted and Indispensable Servant," for you are here laying the foundations for the future life work of many hundreds of chemists, and I welcome the opportunity of telling this group of students something of the fascination and allure of the career of the chemical investigator, and of endeavoring to make clear to my audience why he should be regarded as a useful and irreplaceable citizen.

All chemical industries, as well as a host of others, owe their origin and development to the discoveries of the research chemist. You are all perfectly well aware of this, and I shall not tax your patience by going into details, for I wish to present the subject from a somewhat different point of view.

In ancient times man searched the corners of the then known world for precious spices, perfumes and dyes; great caravans made long and perilous journeys, and galleys plied "the seven seas" on similar errands. Only kings and nobles or the richest of the proletariat could then afford such luxuries. But to-day science, the greatest and most altruistic of all democratizers, has brought all these and thousands of other equally precious substances within the reach of even the poorest of our people.

The "Philosopher's Stone," the "Grand Elixir" or the "Magisterium," as it was variously called in the Middle Ages, sought so eagerly by the alchemists of the Zlata ulička or Gold Alley of Prague, and which was not only to transmute baser metals into gold, but also to restore the dying to life, has at last been found in the trained intelligence and fertile imagination of the scientific investigator. Its name is scientific research, and it is daily transmuting baser materials into products of inestimable value to the community, relieving human suffering, conquering disease and saving human life. It is the mainspring of our progress and the measure of our civilization.

The army of scientific investigators are the real "shock troops" of civilization, always on the firing line and ever penetrating deeper and deeper into the hostile territory of those common enemies of mankind—ignorance and darkness, superstition and intolerance, poverty and famine, disease, pestilence and death.

The value of new facts carefully determined and recorded is not always immediately evident. Years may, and often do, roll by before they are utilized. The late Elbert Hubbard used to say that "in these days, the man who says that a thing can not be done is quite likely to be interrupted by some idiot's doing it." As a child, my parents used to read to me a poem entitled, "Darius Green and His Flying Machine," written in ridicule of the possibilities of aviation. As a boy, I pored with great delight over Jules Verne's "Twenty Thousand Leagues under the Sea," which foreshadowed our modern submarines, and was generally regarded as merely another wild flight of the imagination.

"But would you really like to hear some music?"

I assured her once more that I would.

"Come, then, into the music room," she said, and I followed her into an apartment finished, without hangings, in wood, with a floor of polished wood. I was prepared for new devices in musical instruments, but I saw nothing in the room which by any stretch of imagination could be conceived as such. It was evident that my puzzled appearance was affording intense amusement to Edith.

"Please look at to-day's music," she said, handing me a card, "and tell me what you would prefer. It is now five o'clock, you will remember."

The card bore the date "September 12, 2000," and contained the longest programme of music I had ever seen. It was as various as it was long, including a most extraordinary range of vocal and instrumental solos, duets, quartettes, and various orchestral combinations. I remained bewildered by the prodigious list until Edith's pink finger-tip indicated a particular section of it, where several selections were bracketed, with the words "5 P.M." against them; then I observed that this prodigious programme was an all-day one, divided into twenty-four

sections answering to the hours. There were but a few pieces of music in the "5 P.M." section, and I indicated an organ piece as my preference.

"I am so glad you like the organ," said she. "I think there is scarcely any music that suits my mood oftener."

She made me sit down comfortably, and, crossing the room, so far as I could see, merely touched one or two screws, and at once the room was filled with the music of a grand organ anthem; filled, not flooded, for, by some means, the volume of melody had been perfectly graduated to the size of the apartment. I listened, scarcely breathing, to the close. Such music, so perfectly rendered, I had never expected to hear.

"Grand!" I cried, as the last great wave of sound broke and ebbed away into silence. "Bach must be at the keys of that organ; but where is the organ?"

"Wait a moment, please," said Edith; "I want to have you listen to this waltz before you ask any questions. I think it is perfectly charming"; and as she spoke the sound of violins filled the room with the witchery of a summer night. When this had also ceased, she said: "There is nothing in the least mysterious about the music, as you seem to imagine. It is not made by fairies or genii, but by good, honest, and exceedingly clever human hands." . . .

You may be surprised to learn that I have just been reading from Edward Bellamy's "Looking Backward," written just 50 years ago as a vision of what we might expect by the year 2000. Actually this dream became fact in one quarter of that time. Some one has well said: "Do not despise the dreamer. Be one yourself. For every great achievement is somebody's dream come true." And, as Vice-President Kettering, of the General Motors Corporation, so strikingly puts it, "No one can look into the future except through the windows of the research laboratories."

Many other things which seem impossible to-day will be matters of such everyday knowledge a few years hence as not even to evoke passing comment. The pathetic side of this is the realization that, aside from the fact that our national recovery would thereby be more quickly and more fully realized, an incalculable amount of human suffering and thousands of human lives could be saved by speeding up our research program through more liberal financial assistance. It is your life and the lives of those nearest and dearest to you that are at stake. What are you going to do about it?

Perhaps the most discouraging factor in the present situation is the attitude of our own Federal Government. Although expending billions of dollars, not alone for much-needed relief, but also for about everything else under the sun, the appropriations for the support of research in the all-important domain of the natural sciences have been cripplingly reduced, trained investigators have been turned adrift, to swell the already distressingly large army of unemployed, and taxes have been enacted the effect of which will be so to penalize wealthy individuals as to make it increasingly difficult for those who have heretofore been the principal benefactors of our educational and research institutions to contribute to their support. This, too, at a time when these institutions need such help most urgently, because of the greatly diminished income from their investments.

We flatter ourselves as being the world's most progressive nation, but President Compton, of the Massachusetts Institute of Technology, chairman of President Roosevelt's Science Advisory Board, in his masterly address on "The Government's Responsibilities in Science"[2] remarks that, "It is interesting and somewhat disheartening to note that our country, with all its boasted progressiveness, has paid less official attention to science as a means of combatting our present difficulties than any of the other great powers."

The governments of Great Britain, Italy and Japan are all awake to the dependence of their nations upon science and are officially encouraging its development with steadily increasing liberality. Russia has established, under her Academy of Science, over 200 great research institutes, for work in pure science and engineering, with palatial buildings and the finest equipment obtainable. Her appropriation for these institutes and the advancement of science is reported to exceed any other item in her national budget—even that for military and defense purposes. While our own government, with an appropriation of less than one half of one per cent. of its 1936–1937 budget for the same purpose, staggers along like a drunken sailor, throwing money right and left, content in the fatuous delusion that because of our marvelous inheritance we can hold our place in the sun with the expenditure of the barest pittance for science, and scornfully indifferent to the fact that for a nation, as for an industry, scientific research has ceased to be merely the price of progress. It is to-day the price of existence. Which shall it be, scientific leadership or ultimate national decline and fall?

In recent years there has been much thoughtless railing, often by those who should know better, against science as inimical to the well-being of the race, because of the evil uses to which it is sometimes put. Even the newspapers have carried such scare headlines as "Chain the Mad Dog of Science."

As a direct consequence of the use of so-called "poison gases" in the world war, chemistry and the chemical investigator have been defamed and maligned as being directly responsible for the introduction of this new horror into war. As well might one condemn the manufacturer when a woodman's axe was used to

[2] SCIENCE, 81: 2102, 347–355, April 12, 1935.

murder a neighbor. Should disease germs be employed in future wars, a possibility which has been suggested by various writers, medicine and the medical profession, although wholly blameless, are likely to be subjected to similar abuse.

Practically all the toxic chemicals used to any extent during the world war were well known long before that conflict. They had been discovered by research chemists, in their efforts to contribute to the advance of civilization, and these scientists were assuredly in no way responsible for the pernicious uses to which their discoveries were subsequently put. Some of these chemicals have useful peaceful commercial applications. Phosgene, the chief killing gas employed by both sides in the war, is the initial material for the manufacture of some fine dyes, as well as of certain drugs for the alleviation of human suffering and the cure of disease. Chlorine, the first "war gas," and which served for the manufacture of other deadly gases, is the same chlorine as was used to manufacture the chloroform for surgical operations, and for the preparation of potent healing wound disinfectants, as well as to save our soldiers' lives by sterilizing their drinking water.

Lord Asquith, soon after the close of the world war, wrote:

> The first and most obvious experience of this war is the unexplored and still incalculable effect of the harnessing of science to the chariot of destruction. . . . If she is to be diverted for another 20 years into the further elaboration of the mechanism and chemistry of destruction, we may as well pray for the speediest possible return of the glacial epoch.

And the Right Honorable Richard B. Bennett, Prime Minister of the Dominion of Canada, in the course of an address delivered on Armistice Day, 1934, broadcast over an international hook-up, under the general title of "The Family of Nations," had this to say:

> To chemistry we are indebted for modern anesthetics, which before the 19th century were unknown. Their general introduction into surgical practice is one of the most powerful agencies in the alleviation of human suffering. But to our horror we know that the chemist can appear in a role of devastation to herald a program of destruction and annihilation yet only in its infancy. The inescapable conclusion is this: that the laboratories of science can not be left as the playthings of those who vie with each other in the technique of human slaughter, but must be reclaimed for the beneficial use of mankind.

Scientific knowledge is power and, like any other kind of power, political, financial, or what not, may be used either benevolently or malevolently. Of course, intrinsically power is neither good nor bad. It is only the purpose it serves which can be so described, and this carries the responsibility back to where it obviously belongs, namely, to the individual employing it. As well might one condemn religion, because in its name have been committed some of the bloodiest and most revolting crimes in history. A scientific invention or discovery may be used either for or against humanity, and no one can predict just what will be its final balance sheet. It is manifest, however, that there would be neither scientific discovery nor the dissemination of scientific knowledge, if they were to be limited to those facts which could be guaranteed to have only benevolent applications.

Like an individual, a nation that believes its existence to be at stake is quite certain to make use of any weapons or knowledge likely to aid in its struggle for self-preservation. As science is one of the most potent of all weapons, it behooves us to keep this fact constantly before us.

The Bishop of Ripon suggested nine years ago that all physical and chemical laboratories be closed for a period of ten years, in order to give the world a chance to assimilate the mass of new and undigested knowledge already accumulated. The impracticability and futility of this suggestion were clearly and forcefully presented by a number of writers, immediately following the publication of the bishop's address. And yet the bishop was quite correct in asserting that the discovery of new knowledge is advancing more rapidly than our understanding and utilization of it.

"Some of the appalling contrasts between scientific progress and social stagnation," which confront us so threateningly to-day, as the direct outcome of this lag between knowledge and practice, were vividly set forth in the remarks of Dr. Edwin G. Conklin, as president of the American Association for the Advancement of Science, at the semi-centennial celebration of the Society of Sigma Xi.[3] As new facts are recorded, the possibilities of their interdependences and interrelations increase in geometrical ratio. There are splendid opportunities now for service by those who will patiently and painstakingly study, collate and interpret this overwhelming and rapidly increasing mass of information in all its possible applications and implications.

Some 200 years ago, Sir Joshua Reynolds wrote:

> It is indisputably evident that a great part of every man's life must be employed in collecting materials for the exercise of genius. Invention, strictly speaking, is little more than a new combination of those images which have been previously gathered and deposited in the memory: nothing can come of nothing: he who has laid up no materials can produce no combinations. The more extensive, therefore, your acquaintance is with the works of those who have excelled, the more extensive will be

[3] SCIENCE, 83: 2165, 607–609, June 26, 1936.

your powers of invention, and, what may appear still more like a paradox, the more original will be your conceptions.

The greater the power under man's control, the greater his possibilities for good or evil, and the heavier his responsibilities.

The central and eternal problem is man himself, not science, nor an accumulation of undigested knowledge. Man's mastery over the forces of his universe is growing far more rapidly than he himself is developing the qualifications or character to be safely entrusted with such vast power. It is entirely conceivable that the end of life upon this planet of ours may be brought about by man himself, through the loosing by some miscreant of uncontrollable devastating forces. This thought has been expressed before by various speakers and writers, notably by Bertrand Russell in his "Icarus." Think of the havoc which can be wrought already by such forces as fire and pestilence! The only answer is to breed better humans, and in this scientific research can and will unquestionably play a leading rôle.

To quote once more that great benefactor of mankind, Louis Pasteur:

> Two opposing laws seem to-day to be in combat—a law of blood and death which, daily devising new weapons of war, compels the people to be prepared always for the battlefield; and a law of peace, work and welfare, which is concerned only with the delivery of humanity from the scourges which beset it. The one seeks only violent conquests; the other the relief of mankind. The one places a human life above all victories; the other would sacrifice hundreds of thousands of lives to the ambition of one man.

Our loss in the world war was approximately 50,000 dead; but in the same period 180,000 of our people died of cancer and over 400,000 of influenza. The total deaths in the world war in all countries concerned have been estimated at 10 million or more; yet Pasteur's discoveries have probably saved many more human lives than this. If this seems an extravagant statement, I would remind you that in the year 1347 the Black Death was brought to Genoa from the Crimea by an Italian advocate, Gabriel de Mussis, and in 24 months 25 million people died in Europe of this terrible pestilence.

The chemist's inheritance is a fair land of vast extent, boundless resources and unrivaled opportunities for service. As yet, he has penetrated it to only an infinitesimal extent, but sufficiently far to learn that the farther he advances the more marvelous are the wonders it discloses.

The chemical investigator is a real adventurer and explorer, and the dangers which confront him are just as real and just as great as those which beset the path of him who would force his way through the tropical jungle or brave the rigors of the Antarctic. He has this great advantage over those whose field is merely the superficial physical features of the earth that, whereas already there remains but little of the earth's surface unexplored, even at the poles or in darkest Africa, and this little is rapidly diminishing, the chemical explorer has an ever widening field for his adventures, as each succeeding discovery opens new vistas of the limitless unknown beyond.

It is that vast unknown which ever beckons and lures him on, which he follows with all the zest and excitement of the chase. Like the "call of the wild," it is a call which never fails to awaken a vibrant response in the heart of the born scientist until that heart is stilled and life itself, the greatest adventure of all, is over.

After 40 years' experience, I say without hesitation that there is, in my opinion, no career which can for a moment compare with that of the investigator in the realm of the natural sciences, in the fascination and magic of the work itself, the satisfaction and contentment which flows from doing something which really seems worth while, the inspiration and thrill of seeing a little deeper into the unknown, while still before him, in indistinct and hazy outline, he discerns vaguely great fundamental scientific truths and generalizations, which he knows are there and towards which he eagerly fights his way.

The adventurer in a new land can rarely foretell just what he will find awaiting him when he turns a corner in the trail, or suddenly after a laborious climb emerges upon some mountain top, with the country spread out at his feet. So, the chemical explorer may suddenly stumble upon a wholly unexpected reaction, when in search of something else, as Perkin discovered Mauveine in the search for a quinine substitute, and the industry of synthetic dyes was born. Or he may reach a point from which he can begin to see, even if not clearly in all its details, a marvelous and close genetic and structural relationship, not previously suspected, between important groups of organic compounds. This has been realized just recently by the startling discovery that the morphine alkaloids; the resin acids; the heart poisons of the digitalis and strophanthus group; certain toad poisons; the sterols, bile acids and sex hormones; saponins; certain cancerigenic and estrogenic hydrocarbons; and one of the fungus pigments; are all derivatives of the well-known hydrocarbon, phenanthrene, which is found associated with anthracene in coal tar.

It is this same love of adventure which explains why so many scientists are ardent fishermen, hunters and lovers of the outdoor life.

Like every other human activity, chemical research

has its days of discouragement and depression. But do not believe that defeatist and hopeless saying that "opportunity knocks but once," for opportunity herself has said, in the words of Walter Malone:

They do me wrong who say I come no more,
When once I knock and fail to find you in;
For every day I stand before your door
And bid you wake and rise to fight and win.

CONSPICUOUS ASTRONOMICAL ADVANCES OF THE YEAR[1]

By Dr. HARLOW SHAPLEY
DIRECTOR OF THE HARVARD OBSERVATORY

A SURVEY of some of the most important or most interesting events in the astronomical world during the past year includes stories about the solar system, the galaxy of stars and nebulae and extragalactic objects. Some of these events were predicted, such as the total solar eclipse; others, like the epidemic of new stars, were unexpected.

(1) A new theory of the origin of the solar system —or perhaps it would be better to say a variation and extension of older theories—has been proposed by Dr. R. A. Lyttleton, an advanced student of astronomy at Princeton University. Dr. Lyttleton's hypothesis, which is born out of suggestions by Professor H. N. Russell, makes a decided advance in our speculation concerning the origin of the planets; for he has shown a way in which at least one of the most troublesome objections to earlier theories may be avoided. His theory, in brief, suggests that formerly the sun had a companion star. This companion, after being partially disrupted by the close passage of a third star, long ago deserted the neighborhood, leaving in the sun's gravitational care the debris of the creative encounter. The present planets, formed from the erupted filaments in much the manner described in earlier tidal evolution theories, are endowed with momentum derived from the parent star. The failure to account for the large angular momentum (velocity times distance times mass) of the individual planets has been the principal difficulty in earlier theories. Lyttleton's hypothesis is a step forward, but we must still admit that a completely satisfactory theory of the origin of the solar system does not exist.

In speaking of this problem, we should also point out that Professor Russell's new book on the origin of the solar system certainly can be considered one of the most important publications of the year.

(2) The total solar eclipse of June 19, observed from the Grecian Isles, through Russia and Siberia to the northern Japanese Islands, was the usual mixture of success and sadness. The Harvard–M. I. T. eclipse expedition to Ak Bulak was uncommonly successful, and hundreds of spectrograms were brought back. It will take years to discuss results fully, but preliminary examinations by Dr. Menzel and Dr. Boyce, the leaders of the expedition, show several new coronal lines, and indicate a close connection between high excitation in the chromosphere and the strength of the as yet unsolved coronal radiation. From his infrared eclipse plates Mr. Hemmendinger, of the Harvard expedition, finds a new strong coronal radiation at approximately λ 9800—much farther to the red than any coronal line heretofore known. The new information on coronal lines will greatly assist in the interpretation of the corona and the identification of its material.

(3) Two important additions to the powerful astronomical equipment of the western observatories have been announced. One is a twenty-inch astrophotographic telescope for the Lick Observatory; its four component lens system is designed by Dr. Frank Ross, and is now in the process of manufacture by J. W. Fecker at Pittsburgh. An eighteen-inch Schmidt type camera has been made in Pasadena for installation on Mount Palomar, near the site where the building is now under construction for the 200-inch reflector. The Schmidt camera, the largest of its kind now in America, combines the advantages of speed and achromatism characteristic of reflectors with the large flat star field characteristic of refractors.

(4) The discovery and exploration by Dr. Otto Struve and his colleagues at the Yerkes Observatory of a "red" nebulosity around the bright star Antares was announced at Harvard's Tercentenary Conferences. Nebulae which reflect light of blue stars, such as the Pleiades, have long been known. But this is an important advance in indicating the power of nebulosity to reflect light from red stars. A small Schmidt camera was useful in this research, which was carried on chiefly at the McDonald Observatory on Mount Locke in Texas.

(5) The past year has been conspicuous for a wave of bright novae appearing in the Milky Way. The records of astronomy show no similar frequency. Astronomers were still intent upon the peculiar Nova Herculis that appeared in 1934 when a dozen different observers, on the nights before and after the total solar eclipse, independently discovered the naked-eye Nova

[1] Remarks at the dinner of the American Association of Variable Star Observers, October 17, 1936.

Lacertae. On September 18 Mr. Tamm in Sweden discovered a nova of the slow-rising kind in Aquila; an examination of older plates at Harvard and in Germany showed the nova to have appeared before the end of July, and Miss Harwood's plates at Nantucket first recorded it, below the fifteenth magnitude, on July 17. Nova Aquilae did not attain naked-eye visibility, but an unnamed Japanese observer first reported a fifth magnitude nova in Sagittarius on October 4. Confirmation came from the Cape of Good Hope; this object, Nova number 16 in Sagittarius, has faded rapidly to the eighth magnitude.

To the list of novae in the Milky Way can be added a supernova just found on a Harvard photograph of the southern external galaxy I.C. 4719. This extremely remote object apparently exceeded in brightness the total light of its million-star galaxy. At its brightest the object was of the fourteenth magnitude, but it has now faded hopelessly away.

(6) The misbehavior of the bright northern star Gamma Cassiopeiae has monopolized the attention of astronomers during the past few weeks. Since 1932, according to the University of Michigan, the spectrum of Gamma Cassiopeiae has shown peculiar and numerous changes. Apparently these changes, like rumblings before a volcanic eruption, were preliminary to a general outburst. Abnormal brightness of the star was noted in July by the French observer, P. Baize, but Dr. Marshall's photographs in August showed that it had subsided. Suddenly on the morning of October 5 the star increased about 60 per cent. in its radiation, a change detected by Dr. Cherrington at Delaware, Ohio. The preceding evening Mr. Peltier's observations at Delphos, Ohio, had shown the star in normal light. During the past two weeks Gamma Cassiopeiae has been slowly returning from its maximum magnitude of 1.6 toward normal brightness at 2.25, but it is unlikely that the troubles are over. Both light and spectrum should be carefully watched.

(7) The development of a method for rapid measurement of the velocities of faint stars has been completed during the past year by Dr. B. J. Bok and Dr. S. W. McCuskey, and the first results have been announced. The continuation of the work with northern and southern telescopes will contribute new material during the next two years for the determination of the rotation of the Milky Way and the interpretation of galactic structure.

(8) The granulation of the sun's surface has been analyzed, observationally and theoretically, by Professor Harry H. Plaskett in an important investigation of the brightness, dimensions and meaning of the granulations or "rice grains" which cover nearly uniformly about one half of the sun's surface. Although the granules average more than two thousand miles in diameter, they come and go rapidly, with an average lifetime of only a minute or so. At maximum they are about 10 per cent. more luminous than the intergranular areas, and are indicative of the continual turbulence of the solar atmosphere. Plaskett's results are based on an exceedingly skilful technique in making and analyzing the spectrograms obtained by him with telescopes at Victoria, B. C., and at Oxford.

(9) A new member of the family of the Trojan planets has been discovered by Reinmuth at the Heidelberg Observatory. These distant asteroids move around the sun in the same average period as Jupiter. They are, in fact, managed by that planet. The total number of Trojans now known is eleven. All bear names of the heroes, Greek or Trojan, of the ancient battles before Troy. Number eleven has not yet been named.

(10) The most thorough investigation of the masses of the stars has been completed by Professor Henry Norris Russell. He has studied mainly double stars. He finds that the masses and luminosities are closely related, in confirmation of the well-known theoretical deduction by Eddington.

SCIENTIFIC EVENTS

THE NEW ULTRA-CENTRIFUGE PLANT AT THE LISTER INSTITUTE, LONDON

ACCORDING to an article in *Nature*, the governing body and the director of the Lister Institute entertained on September 29 Professor The Svedberg, of Upsala, and a number of interested physicists, biochemists and biologists on the occasion of the completion of the new ultra-centrifuge plant. In welcoming the guests, Professor J. C. G. Ledingham explained that, in anticipation of Professor Svedberg's visit to London on his way home from the Harvard celebrations, every effort had been made to put the finishing touches to the new installation. Dr. Macfarlane, Lister Institute fellow in biophysics and a former pupil of Professor Svedberg, had been almost entirely responsible not only for the design of the building to accommodate the new plant, but also for the supervision of the lay-out and assembly of all the accessory connections, electrical, optical, refrigerating, etc., carried out by the institute's engineering staff. Throughout the whole work, he had enjoyed the constant advice and cooperation of Professor Svedberg. The total cost of the installation, including the new building, was about £7,000, of which sum the Rockefeller Foundation had contributed £3,400 toward defraying the cost of the new machines.

The new laboratory is specially designed and equipped for investigations into the physical nature of very small particles, particularly protein molecules, but it is hoped also to extend its use to the study of the less well-defined entities such as viruses, phages and antibody complexes.

The ground floor is largely taken up by two ultracentrifuges and their auxiliary machinery. Both machines, which were made in the workshops of the University of Upsala to the design of Professor Svedberg, have optical arrangements which make it possible to observe and photograph the contents of the rotating cell.

The smaller of the two machines is called the equilibrium centrifuge and is used for the determination of absolute particle size or weight. It runs at speeds up to 18,000 r.p.m. and usually for several days and nights continuously. The particles have then ceased moving, and a state of sedimentation equilibrium is set up, which allows of the calculation of absolute size from the final photograph.

The larger machine generates much greater centrifugal forces, up to half a million times gravity, and serves to throw down even the smaller protein molecules completely in a few hours. It is used to measure the sedimentation velocity constant of pure proteins and of the components of a mixture. In the case of native protein mixtures, such as blood serum, it is possible to centrifuge these without previous chemical treatment and to determine from the photographs the concentrations in which the component proteins are present.

On the upper floor a roomy laboratory is provided for general chemical and physical investigations. A smaller room which is maintained at a constant temperature is intended for measurements of pH, conductivity, refractive index and cataphoresis constants. For measurements of the latter an optical system is set up, similar to those on the centrifuges, and this enables photographs to be taken of charged particles migrating in the electric field at a rate which is proportional to their charge. Two modernly equipped dark rooms are provided, and in another room examination of plates is carried out and calculations made incidental to the various techniques in use.

GIFTS AND BEQUESTS TO MUSEUMS

IT is stated in *Museum News* that recent gifts and bequests to museums from individuals amount to more than $464,350. In addition, the Carnegie Corporation of New York appropriated $350,000 for the Carnegie Institute at Pittsburgh, and the Rockefeller Foundation and General Education Board appropriated $2,000,000 for the Oriental Institute.

With the payment on June 6 of a bequest of $10,000 from the estate of Walter B. Scaife, the Carnegie Institute, Pittsburgh, collected the $200,000 which was the condition of an added gift of $200,000 on July 1, 1936, from the Carnegie Corporation of New York for the endowment funds of the institute. A fund of $150,000 started by Willis F. McCook for purchases of works of art was exceeded before July 1 and drew a matching sum also from the Carnegie Corporation.

The Oriental Institute, University of Chicago, has received from the Rockefeller Foundation and the General Education Board an unrestricted appropriation of $2,000,000. This is in addition to a grant of $1,354,722, the unexpended balance of a ten-year appropriation in 1928 to finance expeditions to the Near East.

By the will of Miss Virginia Palmer, of New London, Conn., the Lyman Allyn Museum receives $200,000.

By the will of Zenas M. Crane, the Berkshire Museum, Pittsfield, Mass., receives $200,000 and his collection of paintings and art objects. Provision is made in a codicil for completion of the museum addition started by the testator and his sister, Mrs. Samuel Gilbert Colt.

By the will of Joseph S. Stevens, of Jericho, N. Y., the Charleston Museum, Charleston, S. C., receives $25,000. The sum became available as the museum's share of the purchase price of Mr. Stevens's 1,600-acre plantation, Myrtle Grove, on the Combahee River, S. C.

By the will of Mrs. Roxana Atwater Wentworth Bowen, the Chicago Historical Society receives $15,000.

By the will of William Kennon Jewett, the Metropolitan Museum of Art receives $5,000.

By the will of Emma Toedteberg, the Long Island Historical Society receives $5,000.

By the will of Nora D. Woodman, the New York Historical Society, the National Academy of Design and the New York Public Library receive $5,000 each.

The William Rockhill Nelson Gallery of Art at Kansas City has received an anonymous gift of $2,000 for the library.

The Chandler Chemical Museum, Columbia University, has received a gift of $1,500 from the Chemical Foundation.

By the will of Harry de Berkeley Parsons, the New York Zoological Society receives $750.

By the will of the late Mrs. Emily C. J. Folger, the residue of her estate is left to the trustees of Amherst College for use of the Folger Shakespeare Library at Washington.

By the will of William Louis Abbott, the Smithsonian Institution receives one fifth of the residuary

estate and its choice of his papers and books. The estate was valued for probate at $535,000.

ELECTION OF OFFICERS OF THE NEW YORK ACADEMY OF MEDICINE

AT a meeting of the New York Academy of Medicine on November 7, Dr. James Alexander Miller, professor of clinical medicine at the College of Physicians and Surgeons, Columbia University, an authority on internal medicine and tuberculosis, was nominated to succeed Dr. Eugene H. Pool as president of the academy. Dr. Miller was for nine years president of the New York Tuberculosis and Health Association, and last year was president of the American College of Physicians. He will serve a two-year term.

Other officers nominated were: Dr. Arthur F. Chace, vice-president, for a term of three years, and Dr. Lewis F. Frissell, recording secretary, for a similar period; Dr. Walter L. Miles and Dr. Eugene H. Pool were elected trustees. New members of the committee on admissions are Drs. Isidore Friesner, Thomas T. Mackie, Harold R. Mixsell and Irving S. Wright.

Upon recommendation from the committee on fellowships, six honorary members were elected to honorary fellowships. They are: Dr. Maude E. Abbott, curator of the Medical Museum at McGill University in Montreal; Dr. Walter B. Cannon, professor of physiology at Harvard University; Dr. Jean Darier, dermatologist and honorary physician at the Hospital St. Louis in Paris; Lord Herbert of Ashford, Baronet of Shaston, physician in ordinary to King Edward VIII; Dr. Ernest L. Kennaway, director of the research institute of the Cancer Hospital in London, and Dr. Hans H. Meyer, emeritus professor of pharmacology at the University of Vienna.

The meeting closed with an address by Dr. William Mather Lewis, president of Lafayette College, who spoke on the educational background of professional men.

NOMINEES FOR PRESIDENT-ELECT OF THE AMERICAN CHEMICAL SOCIETY

THE nominations for the office of president-elect of the American Chemical Society made by the local sections have been submitted to the members of the society. The four names receiving the largest vote will then be put upon the final ballot which goes to members of the council, and the election there is final. These nominations as given in *Industrial and Engineering Chemistry* are as follows:

Eugene C. Bingham, since 1916 professor of chemistry at Lafayette College.

W. D. Harkins, professor of chemistry at the University of Chicago.

Arthur W. Hixson, professor of chemical engineering at Columbia University.

B. S. Hopkins, professor of chemistry at the University of Illinois.

Charles A. Kraus, professor and director of chemical research at Brown University.

James W. Lawrie, research chemist of the A. O. Smith Corporation.

Albert P. Mathews, Andrew Carnegie professor of biochemistry and head of the department in the College of Medicine of the University of Cincinnati.

E. Emmet Reid, professor of organic chemistry at the Johns Hopkins University.

Hugh S. Taylor, David B. Jones professor of physical chemistry and head of the department at Princeton University.

James G. Vail, chemical director of the Philadelphia Quartz Company and, since 1924, vice-president of the American Doucil Company.

Frank C. Whitmore, dean of the School of Chemistry and Physics of the Pennsylvania State College.

The following have been nominated to serve as councilors-at-large.

E. K. Bolton, chemical director, E. I. du Pont de Nemours and Company, Inc.

R. A. Dutcher, professor, Pennsylvania State College.

W. L. Evans, professor, Ohio State University.

Per K. Frolich, chief chemist, Standard Oil Development Company.

B. S. Hopkins, professor, chemical laboratory, University of Illinois.

F. A. Lidbury, president, Oldbury Electro-Chemical Company.

Edward Mack, Jr., head, department of chemistry, University of North Carolina.

C. E. K. Mees, vice-president and director of research, Eastman Kodak Company.

R. E. Rose, director of technical laboratory, E. I. du Pont de Nemours and Company, Inc.

Alexander Silverman, professor in the department of chemistry of the University of Pittsburgh.

C. M. A. Stine, vice-president and member of the executive committee, E. I. du Pont de Nemours and Company, Inc.

J. W. Watson, professor and head of the department of chemistry of the Virginia Polytechnic Institute.

RECENT DEATHS AND MEMORIALS

JAMES A. HALL, professor of mechanical engineering at Brown University, died on October 29 at the age of forty-eight years.

DR. OSKAR KLOTZ, professor of pathology and bacteriology at the University of Toronto, died on November 3. Dr. Klotz was professor at the University of Pittsburgh from 1910 to 1920. He was fifty-eight years old.

DR. THOMAS MARTIN LOWRY, since 1920 professor of physical chemistry at the University of Cambridge, died on November 3 at the age of sixty-two years.

DR. GEORGE FORBES, formerly professor of natural philosophy in Anderson's College, Glasgow, died on October 22, aged eighty-seven years. Dr. Forbes took part in the harnessing of Niagara Falls for the production and distribution of power.

Nature reports the death of Sir George Hampson, Bt., formerly assistant keeper in the Natural History Museum, known for his work in entomology, on October 15, aged seventy-six years, and of Dr. E. E. Prince, formerly Dominion Commissioner of Fisheries, Canada, an authority on the life-histories of marine food fishes, aged seventy-eight years.

DR. GIUSEPPE SERGI, professor emeritus of anthropology at the University of Rome, has died at the age of ninety-five years.

A BRONZE plaque in memory of Dr. Daniel Draper, the first meteorologist in New York City, was dedicated at the entrance of the United States Weather Bureau station of the Belvedere Tower Observatory in Central Park on November 8. The speakers were Edward J. Kenny, representing Commissioner Moses, who is responsible for the erection of the tablet; Alfred L. Berthett, a personal friend of Dr. Draper, and Mrs. Catherine Parker Clivette, of Greenwich Village Historical Society. David R. Morris represented the U. S. Weather Bureau. The inscription on the tablet reads: Belvedere Tower. Erected in 1869 as a lookout. It now houses the New York Meteorological Observatory which was founded in 1868 by Dr. Daniel Draper who was its director until his retirement in 1912, at which time the observatory came under the direction of the United States Weather Bureau.

ACCORDING to *Nature* a bronze bust of Dr. Emile Roux was recently unveiled at Angoulême, where addresses were delivered by Professor Marchoux, representing the Paris Academy of Medicine, and Dr. Louis Martin, Roux's successor at the Pasteur Institute.

SCIENTIFIC NOTES AND NEWS

DR. EDMUND EZRA DAY, director of the social sciences at the Rockefeller Foundation since 1928 and of the General Education Board since 1933, has been elected the fifth president of Cornell University. He will succeed Dr. Livingston Farrand, who will retire on June 30, after having served as president for fifteen years. Dr. Farrand joined the faculty of Columbia University in 1893 as instructor in physiological psychology, becoming in 1903 professor of anthropology. From 1914 to 1919 he was president of the University of Colorado. Beginning in 1910, Dr. Day was successively instructor, assistant professor and professor of economics at Harvard University. He was then appointed professor of economics at the University of Michigan, where he organized the School of Business Administration, of which he was the first dean.

DR. SIMON FLEXNER, who recently retired as director of the laboratories of the Rockefeller Institute for Medical Research, has been appointed Eastman visiting professor at the University of Oxford for the academic year of 1937–38.

THE presentation of the Chemical Industry Medal of the American Section of the Society of Chemical Industry to Dr. W. S. Landis took place at a joint meeting with the American Chemical Society at the Chemists' Club, New York City, on November 12. The program was as follows: "The Life and Accomplishments of Dr. W. S. Landis," by Dr. M. C. Whitaker; the presentation of the Chemical Industry Medal by Dr. D. D. Jackson, and the medal address by Dr. Landis on "Concentrated Fertilizers."

Nature states that at a recent meeting the Association of German Röntgenologists and Radiologists in Czechoslovakia decided to found a Jaksch Prize on the occasion of the eightieth birthday of its president, Professor Rudolf Jaksch-Wartenhorst, to be awarded annually to young röntgenologists who have distinguished themselves by good scientific work.

THE Sudhoff Medal of the German Society for the History of Medicine and Natural Science has been awarded to Professor R. Zaunick, of Dresden, for a lecture on Karl Gustav Carus.

DR. KARL KEISSLER, director of the botanical division of the Natural History Museum of Vienna, has been elected a corresponding member of the Field Museum of Natural History, Chicago, in recognition of his services to the museum in connection with its botanical work in Europe.

THE University of Michigan has conferred the doctorate of science on Dr. Reuben Peterson, from 1901 to 1931 professor of obstetrics and gynecology in the Medical School.

DR. ALAN M. CHESNEY, dean of the School of Medicine of the Johns Hopkins University, was chosen president-elect of the Association of American Medical Colleges at the recent Atlanta meeting. He will assume office next October. Dr. Loren R. Chandler, dean of the Stanford University School of Medicine, was elected vice-president.

DR. FRANK G. BREYER, of the firm of Singmaster and Breyer, has been elected president of the Associa-

ion of Consulting Chemists and Chemical Engineers. Dr. Breyer was associated for seventeen years with the New Jersey Zinc Company, serving as research chemist from 1910 to 1912, chief chemist from 1912 to 1917 and chief of research and development from 1917 to 1927.

DR. CHARLES E. MURRAY, acting dean of the Division of Veterinary Medicine at Iowa State College since the death of Dr. C. H. Stange, has been made dean of the division.

DR. DAVID R. BRIGGS, assistant professor of chemistry at the University of Chicago, has been recently appointed associate professor of agricultural biochemistry at the University of Minnesota. During the last seven years he has worked at the Otho Sprague Memorial Research Institute making a physical chemical study of brain and nerve tissues. He succeeds Dr. Henry B. Bull, who left on August 1 to join the staff of the medical school of Northwestern University.

DR. MARGARET FULLER BOOS has been appointed associate professor of geology at the University of Denver.

DR. ROBERT G. INKSTER, professor of anatomy in the Faculty of Medicine of the University of Manitoba, Winnipeg, has been appointed university anatomist at Trinity College, Dublin.

THE board of electors to the professorship of social anthropology of the University of Oxford has appointed Alfred Reginald Radcliffe-Brown, Cambridge, professor of social anthropology, from January 1, 1937.

PROFESSOR DR. LUDOLPH BRAUER, formerly director of the Eppendorfer Hospital and professor of medicine at the University of Hamburg, has retired with the title professor emeritus. He is now living in Wiesbaden.

DR. E. V. MCCOLLUM, of the School of Hygiene and Public Health of the Johns Hopkins University, has been appointed a member of the Vitamin Advisory Board of the U. S. Pharmacopoeia. Dr. McCollum's appointment fills the vacancy created by the death of Dr. Lafayette B. Mendel.

MARTIN ALISTER CAMPBELL HINTON has been appointed keeper of zoology in the British Museum of Natural History in succession to Dr. W. T. Calman, who retires on December 29.

PROFESSOR JOHN MELLANBY, Waynflete professor of physiology in the University of Oxford, has been appointed a member of the British Medical Research Council, in succession to Dr. E. D. Adrian, Foulerton research professor of physiology of the Royal Society and fellow of Trinity College, Cambridge, who retired in rotation on September 30.

THE J. T. Baker Chemical Company research fellowship in analytical chemistry, Eastern Division, has been awarded for the academic year 1936–37 to Herman Yagoda, who will continue his work at Columbia University on the separation of tungsten and molybdenum under the direction of Professor H. A. Fales.

P. J. PARROTT, vice-director and head of the division of entomology of the New York State Experiment Station at Geneva, has left for Cape Town, South Africa, where he will begin a six months' study of major insect pests of deciduous and citrus fruits and methods of control in the fruit-growing sections of South Africa as a special agent of the U. S. Department of Agriculture. He plans to spend a month in Cape Colony, visiting the apple districts, after which he will travel northward to Cairo. He expects to return to Geneva at the end of April.

DR. W. H. HOBBS, professor emeritus of geology at the University of Michigan, has returned from a two months' stay abroad. During this time he was a guest of the British Association for the Advancement of Science meeting in Blackpool and of the International Union for Geodesy and Geophysics meeting in Edinburgh. He also lectured at universities in Sweden and in Germany.

DR. KARL T. COMPTON, president of the Massachusetts Institute of Technology, is announced as one of the speakers at the Atlanta meeting of the Investment Bankers Association beginning on December 2.

DR. BRUNO LANGE, professor of physics at the Kaiser Wilhelm Institute, spoke on October 23 before the technical staff of the Calco Chemical Company on the various applications of the photo-electric cell.

THE twelfth annual Norman Lockyer Lecture of the British Science Guild was given by Lord Rutherford on November 12. The title was "Science in Development." *Nature* states that this was the last occasion upon which the Norman Lockyer Lecture will be arranged by the British Science Guild as an independent body. In future the lecture will be carried on under the auspices of the British Association for the Advancement of Science.

THE Thomas Hawksley Lecture of the Institution of Mechanical Engineers was delivered on November 6 by Dr. Alfred Fowler, emeritus professor of astrophysics at the Imperial College of Science and Technology, London, formerly Yarrow professor of the Royal Society. The subject of the lecture was "The Spectroscope and the Atom."

PROFESSOR B. SAHNI, of the University of Lucknow, has been appointed an honorary professor of the Benares Hindu University. In September he delivered an address before the scientific society of the university on "Early Man in Northern India."

THE meeting of the National Academy of Sciences, to be held at the University of Chicago on November 16, 17 and 18, will open on Monday with an address of welcome by Vice-president Frederic Woodward, of the university, followed by a response by Dr. Frank R. Lillie, president of the academy. A public lecture will be given by Dr. W. K. Gregory, of the American Museum of Natural History, on "Transformations of Organic Designs—Paleontologic Aspects of Organic Evolution." There are sixty papers on the scientific program of which fifteen are by members of the academy.

SECTION C (Chemistry) of the American Association for the Advancement of Science will hold meetings on Tuesday and Wednesday, December 29 and 30, at Atlantic City. On these mornings sessions for contributed papers, in which the Delaware, Philadelphia, Princeton and South Jersey Sections of the American Chemical Society are cooperating, will be held in the Main Convention Room of the Marlborough Blenheim Hotel. Titles and short abstracts of papers should be in the hands of the secretary of the section, Dr. J. H. Simons, Pond Chemical Laboratory, State College, Pennsylvania, by November 28. On Wednesday afternoon in the same room Professor M. Gomberg will deliver his retiring vice-presidential address on "Reducing Potentials of Free Radicals." On Tuesday afternoon in the Como Hall, Chelsea Hotel, there will be a joint session of the Section with Section Q (Education) and with the cooperation of the Division of Chemical Education of the American Chemical Society for the third of a series of three symposia on the relationships of chemistry to education. The subject of this symposium will be "The Preparation of the Teacher of Chemistry." Both chemists and educators will present their points of view and these will be discussed.

THE London *Times* reports that Sir Frank Dyson, formerly Astronomer Royal, visited St. Albans High School for Girls on October 24 to open the Parr Observatory, which was bequeathed to the school by Dr. Alfred Parr, of St. Albans. The observatory was removed from Dr. Parr's garden under the supervision of Dr. W. H. Steavenson, the astronomer, and placed in the school grounds. It is the first observatory to come into the possession of a girls' school.

Nature states that at a meeting of the Advisory Council of the Imperial Institute on Mineral Resources, Sir Robert Hadfield, who is a member of the council and has been interested in the mineral work of the institute for many years past, announced that he wished to make a contribution of £1,000 to promote the compilation of mineral brochures by the institute. In making this offer, Sir Robert emphasized the importance of iron and ferro-alloy metals to the British Empire.

SIR FREDERICK GARDINER has given £10,000 to the University of Glasgow towards the provision of a medical institute to be erected in connection with the Western Infirmary and to be called the Gardiner Medical Institute. This is to be at the disposal of the professor of the practice of medicine for teaching and research purposes. A further £10,000 has already been allocated by the trustees of his brother, the late William Guthrie Gardiner, for the same purpose out of the residue of his trust estate.

YENCHING UNIVERSITY at Peiping has received grants amounting to $25,000, Chinese currency, from the Rockefeller Foundation for the support of research: (1) in study of the insects of the North China pear tree, (2) in the use of night soil and animal fertilizer in the preparation of farm compost, and (3) for nutrition investigations on calcium in the Chinese dietary. The China Foundation (American Boxer Indemnity Fund) is also continuing a grant to aid investigations in the catalytic cracking of vegetable oils.

THE School of Mathematics of the Institute for Advanced Study each year allocates a small number of stipends to gifted young mathematicians and mathematical physicists for the purpose of enabling them to broaden their scientific outlook and to work on their research programs at Princeton in contact with the members of the institute and university faculties. Only such candidates will be considered as have already given evidence of ability in independent research comparable at least with that expected for the degree of doctor of philosophy. Applications for the academic year 1937–38 should be filed before February 1, 1937. Blanks for this purpose may be obtained from the School of Mathematics, the Institute for Advanced Study, Fine Hall, Princeton, N. J.

THE Open Court Publishing Company announces that the publication of the *Open Court* and the *Monist* will be temporarily discontinued. The *Open Court* for October, 1936, and the *Monist* for July, 1936, are the final issues. The company states that "it is hoped to resume publication later, perhaps in altered form, with slightly altered emphasis, but with the same ideals for which both magazines stood."

DISCUSSION

SIGNIFICANT FIGURES IN STATISTICAL CONSTANTS

I WISH to commend the note in SCIENCE of September 25, 1936, by Professor Edward B. Roessler on "Significant Figures in Statistical Constants." The general point made is well taken, and the specific authors cited for disapprobation, Fisher and Tippett, are excellent choices. In regard to the number of figures to be retained in a finally published constant, the rule given to retain no figures beyond the position of the first significant figure in the standard error is quite satisfactory. I can not, however, agree with the rest of the rule to the effect that one more place in computations is sufficient. I have not found it so in all cases. Specifically, in obtaining a least-square solution where three or four parameters are to be evaluated, and therefore that number of simultaneous equations solved, I have found it necessary to retain an exceedingly large number of figures after the decimal point, and that if this is not done large errors may result. The errors arise this way: I multiply the equations through by constants to equalize the coefficients and then eliminate by subtraction. If a considerable number of decimal figures are not retained, when one subtracts one may obtain as a coefficient a quantity approaching zero, in which significant figures have been lost. The fifth or sixth decimal figures may become the first significant figure after subtraction. It is hard to know, or at any rate I have not been able to formulate any simple rule by which one can anticipate in advance at just what places it will be important to retain a large number of decimal figures, and I therefore retain routinely six figures after the decimal point, even if this amounts to twelve or more significant figures. This precaution of retaining so many figures, I have found necessary in practice nowhere but in the solution of simultaneous equations; but it is an illustration of the fact that one can not make any general rule that is simple for all calculations.

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NEW LOCALITIES FOR THE BLACK WIDOW SPIDER

To the thirty-six states and British Columbia, Alberta, Manitoba and Ontario from which black widow spiders, *Latrodectus mactans* (Fabr.), have been recorded,[1] H. M. Field adds Wisconsin[2] and L. H. Townsend southern Illinois and Oregon,[3] which tends to complete the picture of the distribution of this much maligned female. During the past four years of collecting spiders in the Chicago area, I have had the opportunity of adding northern Illinois and Indiana to the range. This leaves only eight states (Minnesota, Iowa, Virginia, Delaware, New Jersey, Connecticut, Rhode Island, Vermont) in which the spider has not been officially recorded. All these states will undoubtedly be put on the black list eventually, as they are surrounded on all sides by states which have this pest.

Around Chicago these spiders are fairly common in localized areas. I have found them in piles of cut wood in the Kankakee Dunes area about ten miles south of Momence, Ill. Their characteristic webs, extending up to low shrubs and down to a hollowed-out burrow in the leaf mould, were also found at the Michigan dunes at Lakeside, the Indiana dunes at most any spot from Gary to Michigan City and the Palos Park Forest Preserve in Illinois. Its obscure nest and shy ways in this region keep it well out of most people's ken. Probably this also accounts for the apparent spread in distribution of this species. Added support to this idea that the apparent spread is merely insufficient investigation is the fact that W. J. Gerhard of the Field Museum has specimens collected in 1908 from Palos Park. So far the spider has not been called to the attention of the public by invading homes or by causing bites, though there is no doubt that the spider is to be found within the region and probably in other spots than those in which it has been encountered.

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CONCERNING A NAME FOR BOTTOM MUD FOOD

DR. ROBERT T. MORRIS[1] has asked for a word (derived preferably from the Greek because companion words have been similarly selected) to signify the food supply in top layers of mud at the bottoms of water masses, whether ponds, lakes or oceans, from which numerous species of animals may derive much or all of their nutriment.

Some of us who consider mud-eating forms in studies of the comparative nutrition of marine animals are particularly interested in the adoption of a suitable word for this kind of food.

We are offering for consideration a basic word *"ilytrophon"* (from ἰλύς, mud, slime, + τροφόν, food). Examples wherein the root prefix is already in use to designate dwelling in or other association with mud,

[1] C. E. Burt, *Jour. Kans. Ent. Soc.*, 8: 4, 117, 1935.
[2] H. M. Field, SCIENCE, 83: 2147, 186, February 21, 1936.
[3] L. H. Townsend, SCIENCE, 84: 2183, 392, October 30, 1936.
[1] SCIENCE, 84: 291, 1936.

sludge, slime, silt, bog or sea bottom are: Ilyanthedwardsiidae and Ilyanthus (hexactinarians which live in bottom mud or sand in the Mediterranean Sea); Ilysia, and Ilysiidae (referring to a group of reptiles, coral snakes, which inhabit swamps, etc., in certain warmer countries).[2]

The root "troph-" is familiar to all as signifying nutrition and might well be carried over into the synthesis of the new word.

We speak of autotrophic or heterotrophic nutrition in organisms; we encounter the same root in prefixes both in general physiology and in medicine; such words as trophic, trophoplasm, trophotaxis, trophoneurosis, trophopathy are some examples.

The word *ilytrophon,* signifying the food materials present in mud, ooze, or bottom detritus, would provide natural derivatives such as *ilytroph* (*n*) a mud feeder; *ilytrophic* (*adj.*) designating the nature of either the food or the habit of consuming it or an animal or fauna subsisting upon muddy substrates; *ilytrophism* (*n*) the name of the mud-eating habit.

Although some other root might be selected as a prefix if one wished to more specifically designate mud on the *bottom,* this would only lengthen the word, making it more cumbersome and difficult to use. Also, the Greek word ἰλύς seems already to mean precipitated or bottom mud, slime, etc., since even "Meeresgrund" (sea bottom) is given as one synonym. It would seem consistent to merely qualify the type of ilytrophic material or fauna under discussion by describing it as marine, oceanic, shore, fresh water, etc., as we do with other terms such as plankton. When we offer a word to signify a mud-eater or bottom feeder such as some of the sipunculids[3] most of us think of animals which consume muddy material lying on the floors of puddles, swamps, ponds, lakes or oceans, whether deep or shallow, and not of other organisms, such as lamellibranchs and tunicates, which filter suspended mud from the water. These latter are, after all, plankton feeders, and their ingestion of mud is probably largely only incidental to their feeding upon plankton.[4]

Addendum. Since this note was first submitted, a note by Professor Glover M. Allen (SCIENCE, 84, 374, 1936) has appeared in answer to Dr. Morris' original notice. Professor Allen proposes words also derived from ἰλύς, such as *ilyon, ilyonic* and *ilyobic,* which are shorter terms than ours. We still feel that the use of the suffix *trophon* has the advantage of specifying the type of *food* which nutrifies various mud-eaters, thus applying directly to Dr. Morris' original request.

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BENTHOS, BENTHIC AND "BENTHOTIC"

UNDER the title, "Wanted: A New Word," the author of the article in SCIENCE (84: 291, 1936) appeals for a companion word to planktonic, to use in place of "benthotic," which he cites as being awkward. He further states that "according to the dictionary 'benthos' relates to the bottom of the sea," and that this "is not descriptive in application for the food of many forms of aquatic life living in shallow waters."

The Webster,[1] Standard[2] and Century[3] dictionaries unfortunately define benthos only in the approximate sense above quoted, but use benthic and/or benthonic as its adjectives, and not benthotic. (The term benthal is variously defined by these dictionaries, and for this reason should perhaps be left out of this discussion.)

It is to be regretted that the writer of the previous article in SCIENCE, besides consulting Greek and Latin scholars and the dictionary, as he says he did, had not also turned to biologists and their writings, for benthos and its adjective benthic are well established in the accepted limnological and general hydrobiological literature as designating *all* freshwater bottom-dwellers as well as marine organisms. The two following authorities are cited.

Paul S. Welch, in his "Limnology" (1935), the standard general treatise on limnology in the English language, defines benthos as follows: "The term benthos designates the whole group of bottom-dwelling organisms. Burrowers, clingers, mere crawlers on the bottom, hiders among bottom materials, case or tube forms, sluggish phytophiles, and bottom associates of other kinds compose this group." And further: "It must be understood that the term includes the organisms of the bottom *from the water's edge down to the greatest depths.*"[4]

Academician S. A. Zernov, the Russian hydrobiologist, in his "General Hydrobiology" (1934, in Russian) uses the term benthic (benticheskiĭ) as a synonym of bottom-dwelling and as the adjective of benthos.

If it is a further subdivision of the word benthos that is desired, to cover only "the top layer of mud," then reference should be made to Welch's (*loc. cit.*) comprehensive discussion of the ooze-film assemblage

2 Zoologisches Wörterbuch, by G. Niemann and H. L. Honigmann. Publ. by A. W. Zickfeldt, Osterwieck am Harz, 1919.

3 F. Peebles and D. L. Fox, *Bull. Scripps Inst. of Oceanography,* Tech. Ser. Vol. 3, 201–224. Univ. of Calif. Press, 1933.

4 D. L. Fox *et al.,* Bull. Scripps Inst. of Oceanography, Tech. Ser. Vol. 4, 1–64. Univ. of Calif. Press, 1936.

1 Webster's New International Dictionary, 2nd ed., 1934.

2 New Standard Dictionary, 1929.

3 The New Century Dictionary, edition of 1934.

4 Italics by the writer.

and the littoral, sublittoral, profundal and abyssal benthos.

LEO SHAPOVALOV

CALIFORNIA DIVISION OF FISH AND GAME
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FOOD OF MUD-DWELLERS

IN reply to Dr. Robert T. Morris's request for an adjective to define food derived from the top layer of mud, I submit *acropelotic* (ἄκρος, top; πηλός, mud).

AGNES DE SALES

COLLEGE OF MT. ST. JOSEPH-ON-THE-OHIO

AN interesting point in ecology is raised by Dr. R. T. Morris in SCIENCE (84: 291, 1936) regarding a technical term descriptive of the nature of the food of mud-dwelling organisms. It may be suggested that while the food-stuff is of detrital origin, the food supply considered as their source of energy might be characterized as ilyodynic.

Since the above was written, an excellent choice of terms has been submitted by Professor Glover M. Allen (SCIENCE, 84: 374). The word now introduced, though partly redundant, may perhaps be allowed to stand for final selection.

A. WILLEY

MILLE ISLES,
QUEBEC, CANADA

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE CANCER SYMPOSIUM OF THE MEDICAL SCIENCES SECTION

THE Section on Medical Sciences of the American Association for the Advancement of Science has arranged for the Christmas meetings a symposium on cancer consisting of a series of seven sessions to be held from Tuesday to Friday, December 29 to January 1, inclusive. The first session, which will be held on Tuesday morning, will be devoted to questions concerning radiation, while the afternoon session will be devoted to various aspects of the relationship of hereditary and constitutional factors to the occurrence of tumorous growth. The two sessions on Wednesday will be concerned with the induction, stimulation and inhibition of tumors. This will involve a consideration of the carcinogenic substances, the relationship of the sex hormones and the significance of viruses and of inhibitory substances to the etiology and development of tumors. On Thursday morning tissue culture work in connection with cancer will be discussed and the metabolism of cancerous tissue will be considered. In addition to these sessions, there will be two general lectures, one on Thursday afternoon and one on Friday, which will take up certain more general aspects of the cancer problem. The section is anxious to make this as worth while a symposium as possible and has brought together the leaders in the various fields. In so doing it hopes that it will call attention to the fundamental work that is going on in this country in the investigation of this serious problem and will afford an opportunity for an authoritative survey of the actual status of this field.

The session on radiation will be opened by Dr. Tuve, of the Terrestrial Magnetism Laboratory, Carnegie Institution, who will review for the group the artificial sources of high energy radiations and their applications from a purely physics standpoint. This will be followed by papers by Dr. Lauriston S. Taylor, of the United States Bureau of Standards, who will compare the methods of determining the quality of x-rays, and Dr. G. Failla, of Memorial Hospital, New York City, who will discuss some biophysical aspects of radiation therapy. A comparison of the effects of x-ray and neutrons on normal and neoplastic tissue will then be made by Dr. John H. Lawrence, of Yale University. The effect of alpha particles and their relationship to the effect of neutrons will next be discussed by Dr. Raymond E. Zirkle, of the University of Pennsylvania. Dr. Stafford L. Warren, of the University of Rochester, will then present his work on the combined effects of roentgen-radiation and fever upon malignant tissues. The session will be brought to a close by Dr. Robley Evans, of the Massachusetts Institute of Technology, who will report on the recent progress in the study of radium poisoning. It might be mentioned that the Medical Sciences Section has cooperated with the American Physics Society and the Section on Physics in the arrangement of the days for their respective symposia. The latter organizations are planning a series of papers on radiation on Monday, taking up the more physical aspects of radiation, while the Medical Sciences Section in its radiation session will take up mainly the biological aspects of radiation, except for the orientation paper by Dr. Tuve, which in a sense will form some continuity between the two programs. The combined program should present a very thorough survey of the newer developments in the field of radiation.

The session in the afternoon will present a series of papers on a variety of aspects of heredity and constitutional factors in their relation to tumorous growths. Such considerations as the respective rôles of heredity and somatic mutation in the etiology of

tumors induced by parasites and chemical irritants, the factors of heredity, age and acquired hypersensitiveness in relation to cancer, the relation between the histology of spontaneous mouse tumors and the genetic constitution of the animals in which they arise, and the genetics of mouse leukemia and various other papers of similar nature will be presented.

The session on induction, stimulation and inhibition of tumorous growth will devote considerable time to the discussion of compounds. As is well known, tremendous activity has been exhibited in this field of late, and this symposium will afford an opportunity of presenting a number of views on this question. The session will be opened by Dr. Louis F. Fieser, of Harvard University, who will discuss the chemical aspects of the carcinogenic substances and the indications which can be drawn from the chemical structures regarding the relationship between carcinogenic action and the sex hormones. This paper will be followed by others on various phases of carcinogenic substances and a number of papers on the relationship of the sex hormones to the cancer problem. At this session will also be given papers on the significance of viruses and of inhibiting substances in connection with tumors.

Thursday morning will be devoted to the consideration of questions closely related to the metabolism of cancerous tissue. The session will be inaugurated by Dr. Warren H. Lewis, Carnegie Institution, who will discuss the cultivation and cytology of cancer cells. This will be followed by a critical analysis by Dr. Dean Burk, of the United States Department of Agriculture, of our present knowledge of the intermediary carbohydrate metabolism of tumors and the significance of the Pasteur-Meyerhof reaction in the light of recent work. The relationship of protein metabolism to malignant growth will be discussed by Dr. Carl Voegtlin, National Institute of Health, while the rôle of the amino acids and the nucleic acid derivatives in developmental growth and their possible significance to the cancer problem will be presented by Dr. Frederick S. Hammett, of the Research Institute of Lankenau Hospital. The session on metabolism will be closed by a discussion of the distribution of inorganic salts in cells and tissues with particular reference to such studies of cancerous cells by the micro-incineration technique.

The two general papers will be given by Dr. C. C. Little, of the Roscoe B. Jackson Memorial Laboratory, and Dr. Walter Schiller, of the University of Vienna. Dr. Little will present a general lecture for not only Section N but for the entire association at 4:30 on Thursday and his subject will be on the social significance of cancer. Dr. Schiller will lecture at 4:30 on Friday afternoon on changes and modifications in the conception of carcinoma. It may also be mentioned that the American Society for the Control of Cancer has been invited by the association to hold an exhibit on various aspects of the social control of cancer.

In addition to the cancer symposium the Medical Sciences Section is planning to hold a joint session with the pharmacy subsection on Monday afternoon and the general session for the presentation of general papers will be held on Friday morning.

The association has been invited to hold the last day of the meetings on Saturday, January 2, at Philadelphia. Accordingly, the Medical Sciences Section plans to hold one session on Saturday morning at 10:30 at the Philosophical Society in Philadelphia and has invited Dr. Wendell Stanley, of the Rockefeller Institute, Princeton, N. J., to give a lecture regarding the interesting and important work that he has been doing on the tobacco mosaic virus which he has succeeded in crystallizing. The afternoon will be devoted to visiting the various medical scientific laboratories in Philadelphia.

VINCENT DU VIGNEAUD,
Secretary of Section M

MEDICAL SCHOOL,
GEORGE WASHINGTON UNIVERSITY

SPECIAL ARTICLES

NITRIFICATION IN PRESENCE OF ORGANIC MATTER

IT is well known that, when cultured in artificial media, the nitrifying organisms, *Nitrosomonas* and *Nitrobacter,* are paralyzed even by very minute quantities of organic matter. On the other hand, nitrification in nature, especially in soil and sewage, proceeds in presence of fairly large quantities of organic matter. This incompatibility of behavior of the classical nitrifying organisms in pure artificial cultures and in their natural environments may be explained as due to one or more of the following:

(1) The nitrifying bacteria function in association with the saprophytes of the soil.[1]

(2) There are in soil several strains of organisms other than the classical nitrifiers which could tolerate fairly large quantities of organic matter and nitrify ammonia.[2]

(3) All nitrifiers are heterotrophic at some stage of their lives.[3]

[1] W. Omeliansky, *Centralb. für Bakt. Abt.*, 2, 5, 473, 1899.

[2] D. W. Cutler and B. K. Mukerji, *Proc. Roy. Soc.*, B 108, 334, 1931.

[3] N. W. Barritt, *Annals Appl. Biol.*, 20: 165, 1933.

No conclusive evidence on these interesting points, however, has so far been available.

Some systematic studies were therefore carried out by the author with cultures of *Nitrosomonas* in an Omeliansky medium to which different forms of soil and other micro-flora were added, both by themselves and in presence of various forms of organic matter. As a result of these, it was found that, although the organic matter tended to depress nitrification when *Nitrosomonas* was present by itself, the adverse effect was completely removed in presence of other organisms. In most cases there was also enhanced nitrification. Fig. 1 will illustrate the type of results obtained.

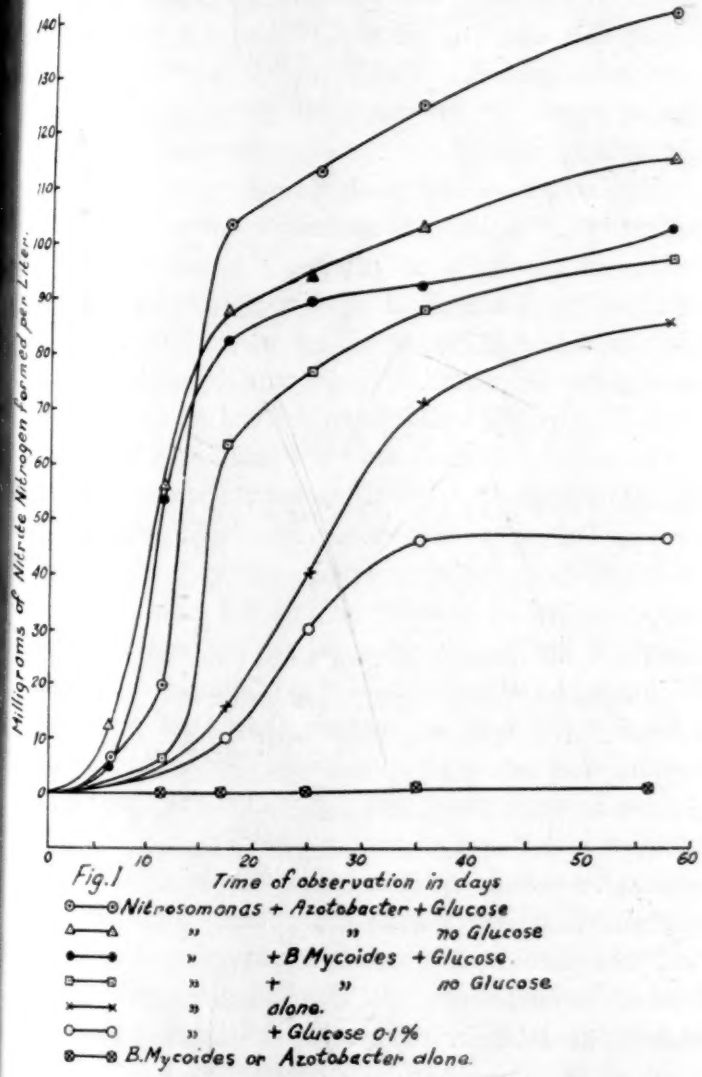

Fig. 1

Exactly similar results were obtained when these experiments were repeated in presence of soil.

These and other observations would show that by utilizing the interfering organic matter in some way, the associated saprophytes assist *Nitrosomonas* in its function. The exact mechanism by which nitrification is stimulated in some of these cases is still obscure. Nevertheless, a correlation is possible between nitrification in pure cultures and that in soil if we assume the occurrence of a regulated *Chemomixotrophic* metabolism for these organisms. Further work on this and related aspects of the problem is in progress and will be reported elsewhere.

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POSSIBILITY OF PARTHENOGENESIS IN GRASS

MANUALS agree quite unanimously that buffalo grass (*Buchloe dactyloides* (*Bulbilis,* Raf.) is dioecious, and that vegetative branches propagate only their own kind—either male or female. Sodded areas are usually and preponderantly of either staminate or pistillate plants only. This fact permits removal of large sods of each sex. Pistillate plants are generally so short that mowing is of small consequence and they have been utilized as a "self-mowing" or lazy man's lawn grass!

Thus far the genus Buchloe has been monotypic with little possibility of mistaken identity except in the vernal or juvenile stages with curly mesquite, *Hilaria belangeri,* a strictly monoecious and perfect-flowered grass which grows only in the southern end of the buffalo grass zone. The famous tree "shelter belt" passes through the heart of the recognized buffalo grass area. Hitchcock[1] says it is "probably the best known range grass—a sod-forming short grass dominant over much of the Great Plains—the foliage cures on the ground and furnishes nutritious feed during the winter. The sod houses of the early settlers were made mostly from the sod of this grass."

Only limited quantities of buffalo grass seed have been harvested because the staminate flower is located so near the soil surface and the seeds are formed below the reach of ordinary harvesting tools. Recently seed has been harvested by means of vacuum suction and by hand picking.

In the spring of 1935 some tall-growing plants were found with elevated pistillate spikelets which if reproduced would make it possible to harvest the seed crop with a mowing machine such as is ordinarily used on the farm, provided the seed would remain attached. Since buffalo grass can be propagated vegetatively the prime utility of this selection might be its hay- and pasture-producing potentiality. Quinby of the Texas station[2] has reported recently 2,423 pounds of buffalo grass hay per acre in comparison with 1,673 pounds of Sudan grass. The first mowing of our own planting produced in the summer of 1936 on four 10,000th acre plats an average rate of 3.08 tons of air dry hay per acre.

When the hay was removed a number of well-devel-

[1] A. S. Hitchcock, Misc. Pub. 200, U. S. D. A. 1935.
[2] B. C. Langley, *Capper's Farmer,* September, 1936.

oped fruits were found, some of which contained fully developed seeds (caryopses). Careful examination of this pistillate planting during the season did not disclose any staminate or perfect or hermaphrodite flowers. Hitchcock[3] reports that seedlings of *B. dactyloides* are monoecious, producing both staminate and pistillate branches which produce their own kind.

Experiments are now under way to make certain that no outside pollen will enter the place where we are attempting to produce a new crop of (unfertilized?) buffalo grass seed. If such caryopses materialize the first authentic instance of parthenogenesis in grass may become established, in so far as the writer is able to find in a search of the literature at hand.

The material providing this study came from 25 pistillate rooted branches set in a small plat of 50 square feet. From 865 spikelets 53 apparently clean and 341 diseased caryopses were obtained. The disease which resembles smut has been identified by Gertrude Tennyson as *Cercospora seminalis* Ell & Ev., an imperfect fungus. This and other fungi (*Helminthosporium*) are reputed to be the cause of considerable amount of the very low germination percentage of buffalo grass seed.

An attempt is being made to grow plants from some of the caryopses collected from this material. Recently, 30 caryopses from this plat were planted, 8 of which germinated. Of this number 6 plants survive at the time of writing, and this is admitted to be a very satisfactory percentage by local workers in this field of research. If the seeds from which these plants came were produced by fertilization with pollen it must have come from scattered staminate plants in the neighborhood or possibly from plants miles away and carried in by insects or on the balmy air of Oklahoma. Seeds of Dallis grass, *Paspalum dilitatum,* have been gathered in the air 5,000 feet above the city of New Orleans. Pollen grains of other plants have been gathered at a much greater height.

This report is being made at this time and place in the hope that it may come to the attention of others who may be interested and who will contribute additional information on the subject.

W. B. GERNERT

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PHOTOCHEMICAL OXIDATION OF AMMONIA IN SEA WATER[1]

PHOTOCHEMICAL transformations between ammonia, nitrite and nitrate have been frequently reported under a variety of conditions[2, 3, 4, 5]. Recently Drs. S. A. Waksman and C. L. Carey, of the Woods Hole Oceanographic Institution, and one of us (A.H.), carried out a number of qualitative tests for nitrite in sea water irradiated after the addition of nitrate and ammonia. These preliminary results, which will shortly be published, as well as the work of ZoBell[6] on the photochemical oxidation of ammonia, suggested a more quantitative study.

Accordingly, ammonium sulfate was added to sea water from various sources, and to distilled water, and determinations made for ammonia and nitrite before and after irradiation with ultra-violet light. Confirmation was so easily obtained of the change of nitrate to nitrite in sea water that further investigation of this was deemed superfluous for this preliminary investigation. Furthermore, the slow destruction of nitrite in sea water by ultra-violet light was conclusively shown, but the corresponding process in distilled water seemed much slower, even doubtful.

Finally, attention was entirely centered on the oxidation of ammonia to nitrite. Ammonia was determined by the method of Krogh,[7] which has been slightly modified to serve as a routine analytical method for sea water. Nitrite was determined colorimetrically by the well-known method of Griess.

The solution in each case was irradiated in a cell of 15 mm depth with crystalline quartz windows 70×16 mm, sealed on with picein. The light from a high pressure water-cooled quartz capillary mercury-vapor lamp,[8] operated at 150 v. and 3.5 amp., was concentrated on the exposure cell. The radiation from the lamp (1,950 to 9,000 Å) was of considerably higher intensity per unit of surface than that given by a commercial mercury-vapor lamp. Since the radiation passed through one cm of tap water, one fused quartz window and 25 cm of air, in addition to a crystalline quartz lens and window before entering the cell, it contained extremely little radiation below 2,200 Å.

The control cell was of construction identical to that of the exposure cell, but had glass windows and was painted black. The solutions in both cells were kept at 20° C. and stirred thoroughly.

Results showing the change of ammonia to nitrite are given in Table 1. All figures represent nitrogen in micrograms per liter.

In Sample 3 approximately one mg of ammonia-nitrogen was added per liter, but was not determined

[3] A. S. Hitchcock, Bul. 772, U. S. Department of Agriculture, 1920.

[1] Contribution No. 120 from the Woods Hole Oceanographic Institution.

[2] H. Thiele, *Ber. deutsch. chem. Ges.*, 40: 4914, 1907.
[3] B. Moore, *Proc. Roy. Soc.*, B., 90: 158, 1918.
[4] D. S. Villars, *Jour. Amer. Chem. Soc.*, 49: 326, 1927.
[5] N. W. Rakestraw, *Biol. Bull.*, 71: 133, 1936.
[6] C. E. ZoBell, SCIENCE, 77: 27, 1933.
[7] A. Krogh, *Biol. Bull.*, 67: 126, 1934.
[8] F. Daniels and L. J. Heidt, *Jour. Amer. Chem. Soc.*, 54: 2381, 1932.

TABLE 1

Sample No.	Description	Time of irradiation	Micrograms per liter: Ammonia-nitrogen	Nitrite-nitrogen	Ammonia loss
1.	Distilled water	0	890	0	
	+ NH_3	2 hr.	940	0	
2.	Distilled water	0	980	0	
	+ NH_3	2 hr.	940	0	
3.	Surface sea water	0	1000 ±	0	
	+ NH_3	1 hr.	....	112	
4.	Same	0	980	0	
		2 hr.	490	335	490
5.	Same	0	970	0	
		2 hr.	740	166	230
6.	Same	0	970	0	
		2 hr.	600	270	370
7.	Same, but radiated through Uviol filter	0	960	0	
		3¼ hr.	780	35	180
8.	Surface sea water, same as 3, 4, 5, 6, 7, but no added NH_3	0	68	0	
		1½ hr.	26	++	
9.	Sea water from wharf + NH_3	0	850	0	
		1 hr.	670	125	180
10.	Deep sea water + NH_3	0	940	0	
		1 hr.	740	270	200*

* Nitrate content of this water was 265. All other samples nearly nitrate-free (10–25).

quantitatively, either before or after radiation. In Sample 8 so much of the solution had to be used for the ammonia analysis that there was only enough remaining for a qualitative test for nitrite, which was very distinctly positive. No. 10 was from a mixed sample taken from a number of sources, all below 1,000 meters in depth, and consequently with a high nitrate content. The fact that the nitrite produced exceeded the ammonia lost in this sample is evidently due to simultaneous reduction of nitrate.

It is to be observed that the photochemical oxidation of ammonia takes place in sea water but not in distilled water, confirming in quantitative form ZoBell's earlier observations.

Passing the radiation through a Uviol filter in No. 7 reduced its efficiency considerably, and the questions arising from this fact will be the subject of further study.

With the exception of this sample and No. 10, already mentioned, a relatively constant proportion (68 to 73 per cent.) of the ammonia is transformed into nitrite.

This whole work must be considered preliminary to a more complete study of the extraordinary conditions surrounding photochemical actions in sea water.

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ALEXANDER HOLLAENDER
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AND UNIVERSITY OF WISCONSIN

SCIENTIFIC APPARATUS AND LABORATORY METHODS

STOP-COCKS FOR MECHANICAL OPERATION

GLASS stop-cocks have been incorporated in mechanical devices, but they are not well suited to this type of service because the amount of energy required to turn them is not constant but increases as the film of sealing compound wears thinner, which in turn may interfere with the operation of the device or may break the stop-cock. When a glass stop-cock is operated mechanically some provision must be made constantly to press the core inward as it is turned. Finally, the fact that glass stop-cocks are so subject to breakage when used as part of mechanical devices makes them unsuited to this kind of use.

A metal stop-cock,[1] used as part of a mechanical device, has been described. This stop-cock is used under conditions which are such that slight leaks are of no consequence.

The stop-cocks shown in Fig. 1 are of mild steel with the exception of the cores. Chrome steel is used in the cores to avoid the excessive friction which is produced when two surfaces of the same metal move against each other.

[1] C. F. Winchester, SCIENCE, 78: 2035, 607, December 29, 1933.

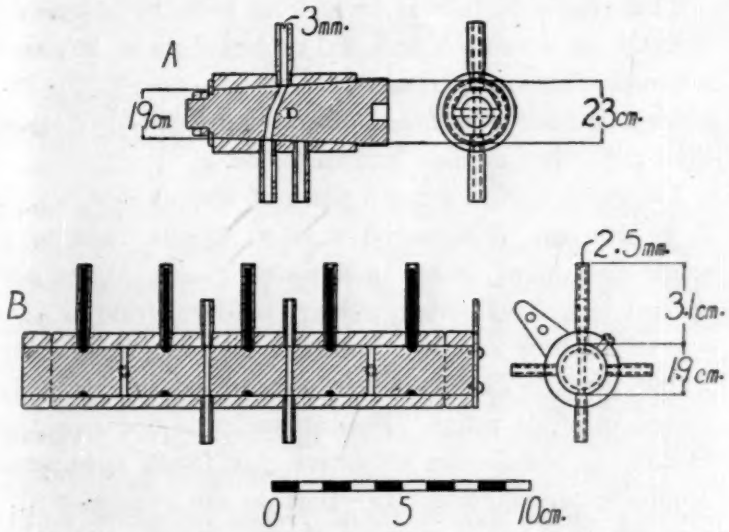

FIG. 1. A. Stop-cock of mild steel with chrome steel core held securely in place by nuts and a washer. B. Four mercury-sealed two-way stop-cocks in one unit. Core is of chrome steel, other parts are of mild steel.

The stop-cock shown at A in Fig. 1 differs in two respects from the conventional type, aside from the fact that it is of metal. The core is held in place by nuts and a washer just tightly enough to prevent leaks, but not tightly enough to cause undue friction. Holes in the core are not parallel, but as shown in the end view of the device are at right angles to each other.

Thus it is necessary to turn the core through a ninety degree arc only. This has been found to be of decided advantage when the stop-cock is operated mechanically. A similar stop-cock with a bronze core has been made. The advantage of the steel core is the fact that it can be used in positions in which there is a possibility of its coming in contact with mercury. These stop-cocks are used in gas analysis apparatus.

The device shown at B in Fig. 1 consists of four, two-way stop-cocks, in one unit, each sealed by mercury under a pressure of about three centimeters. Over a period of about a year it has given satisfactory service as part of a device for obtaining aliquot samples of air.

The core and shell of the mercury-sealed stop-cock were machined until a very close fit was obtained and were then run together in the lathe, well lubricated with a light grade of oil, until the parts were worn enough to permit reasonably free movement. Taper of the core is 0.003 mm per cm length.

When sealed with graphite, no leaks could be found in the mercury-sealed stop-cock under pressure of 30 cm of water.

C. F. WINCHESTER

COLLEGE OF AGRICULTURE
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DAVIS

FIXATION OF SESSILE ROTATORIA

THE sessile Rotatoria have long been notorious as difficult to narcotize and fix extended in a life-like manner. The proper use of Zenker's fixing solution gives a greater percentage of well-extended specimens than any other method known to me.

The rotifer, with a small piece of the plant to which it is attached, is removed with a pipette to a very small amount of water in a watch glass. When the animal is well extended, a large amount (one or two cc) of boiling Zenker's solution is poured into the watch glass. The specimen should be immediately rinsed in clean water. Boiling water is not as satisfactory as the Zenker's fixative, for fewer specimens remain extended, and those that do are generally distorted.

This method usually works well with *Stephanoceros, Collotheca* and the smaller Floscullariidae, but it generally fails with the genera *Floscularia* and *Limnias.*

I am working on a taxonomic monograph of the sessile Rotatoria (families Collothecidae, Conochilidae and Floscullariidae) and am eager to see material from any part of the world. Such material will be acknowledged in the monograph.

W. T. EDMONDSON

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YALE UNIVERSITY

SIMPLE AID FOR COUNTING CROWDED PLATES

RECENTLY we have had occasion to completely count all the bacteria colonies on a large number of moderately crowded plates (400 to 600 colonies per plate). This was done with the aid of a Lumi-lens type illuminator, having a Jeffers Plate Counter card and a 3X lens. The count was recorded with a hand tally.

The method of procedure was to count the colonies in each of the ten pie-shaped sectors in turn, starting at the apex and working back and forth, section by section within the sector out towards the edge of the plate, moving clockwise around the plate from sector to sector.

Since all the dividing lines on the Jeffers Plate Counter were white, we had to be continually on the alert that in our concentration on spotting each of the many colonies our eyes did not occasionally and accidentally pass over the sector boundary line, giving us a double count on some colonies. This became especially troublesome when counting near the edge of the plate where there are a multiplicity of radial lines.

By a simple device this error due to eye confusion was eliminated and the counting of the plates made less tiring and more accurate. The ten radial lines from the center to the periphery of the chart were lightly colored with green ink (almost any contrasting color but black will serve as well). Each pie sector was then outlined from apex to outer edge in green. Thereafter in counting a plate one's entire attention could be devoted to spotting colonies, since the eyes, approaching the colored boundary line, would be warned and turn back into the sector being counted rather than wander erroneously into the adjacent sector.

T. H. BUTTERWORTH

SYRACUSE, N. Y.

BOOKS RECEIVED

DESCHIN, JACOB. *New Ways in Photography.* Pp. xiv + 307. 36 plates. Whittlesey House, McGraw-Hill. $2.75.

ECKLES, CLARENCE H., WILLES B. COMBS and HAROLD MACY. *Milk and Milk Products.* Second edition. Pp. xiii + 386. 92 figures. McGraw-Hill. $3.50.

Eugenical Sterilization; A Reorientation of the Problem. By the Committee of the American Neurological Association for the Investigation of Eugenical Sterilization. Pp. 211. 9 figures. Macmillan. $3.00.

GATHERCOAL, EDMUND N. and ELMER H. WIRTH. *Pharmacognosy.* Pp. 852. 372 figures, 1 plate. Lea and Febiger. $7.50.

MCCLENDON, J. F. and the late C. J. V. PETTIBONE. Sixth edition, revised. *Physiological Chemistry.* Pp. 454. 34 figures. Mosby. $3.50.

TAYLOR, GRIFFITH. *Environment and Nation; Geographical Factors in the Cultural and Political History of Europe.* Pp. 571. 147 figures. University of Chicago Press. $4.00.